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SHORTER ARTICLES AND DISCUSSION

RHYTHMIC SYNCHRONISM IN THE CHIRPING OF CERTAIN CRICKETS AND LOCUSTS

SYNCHRONISM in the rhythmic chirping of the snowy tree cricket, *Œcanthus niveus* De G., has been observed and mentioned by a number of able observers, including Burroughs, Thoreau, McNeill and Dolbear. The synchronous chirping of this particular cricket has been too generally observed to be considered merely an illusion of the mind. In a previous paper[1] I reported that I had observed the occurrence of rhythmic synchronism in the chirping of colonies of the tiny tree crickets, *Cyrtoxipha columbiana* Caudell in Georgia. During the summer of 1917 I was afforded an excellent opportunity to make further observations of the synchronous chirping of these interesting arboreal crickets near Vinson Station, Virginia. A little colony had become located in the crown of a small black cherry tree in my back yard, where I could readily keep them under observation at all times. During the latter part of August, when the chirping season was at its height, a remarkable degree of synchronic rhythm characterized their chirpings during warm, quiet evenings. So constant was this rhythmic synchronism that only now and then would any irregularity occur. It finally occurred to me that I could subject their consecutive chirpings to a fairly accurate statistical analysis in the following manner. With a tablet of paper and a pencil I made a short horizontal dash for those instances when the chirpings were in unison, and a short vertical dash when they were not in unison. In this way I was able to record the consecutive chirpings for certain periods of time. In order to illustrate this method, I will give a graphic expression of the first period, which included 98 consecutive chirpings, 8 of which were not in unison.

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Fourteen different periods of consecutive chirpings were recorded in this manner, the results of which may be noted in the following table:

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[1] "Synchronism and Synchronic Rhythm in the Behavior of Certain Creatures," AM. NAT., Vol. 51, July, 1917.

TABLE I

STATISTICAL ANALYSIS OF 14 DIFFERENT PERIODS OF CONSECUTIVE CHIRPINGS OF A COLONY OF CRICEKTS OF THE SPECIES *Cyrtoxipha columbiana*

Period	Consecutive Chirpings Recorded	Chirpings in Unison	Per Cent. of Chirpings in Unison
First	98	90	91.8
Second	79	72	91.1
Third	85	72	84.7
Fourth	23	21	91.3
Fifth	78	72	92.3
Sixth	84	79	94.0
Seventh	66	59	89.3
Eighth	73	69	94.5
Ninth	45	44	97.7
Tenth	23	19	82.6
Eleventh	71	68	95.7
Twelfth	21	21	100.0
Thirteenth	75	74	98.6
Fourteenth	49	48	97.9
Total	870	808	92.8

From these data it would appear that out of a total of 870 chirpings observed, 92.8 per cent. were in unison. Even granting that some errors have been made in these determinations, it is quite evident that this observed high percentage indicates that a remarkable degree of synchronic rhythm occurs.

I kept this particular colony of four or five crickets under observation for a long time, and this rhythmic synchronism was always very noticeable. These crickets chirp most actively just before sundown. At this time every individual chirps briskly, and it is not long until chirping in unison is gradually established. This rhythmic synchronism does not take place at once, but becomes evident after the crickets have been chirping steadily for some time. When this rhythmic unison is fairly established it appears difficult for the crickets to chirp otherwise, for if there is any tendency toward asynchronous chirping, it is quickly overcome. A remarkable feature of the chirping of these crickets is a tendency now and then for the chirping to become noticeably accelerated briefly. Even though this occurs, the entire group keeps pace, so that the same unison is maintained.

The mole cricket (*Gryllotalpa borealis* Burm) is not an uncommon species in low grounds in this part of the country. Its notes are low, mellow, intermittent chirpings—gur-r-r-r-r, gur-r-r-r-r, gur-r-r-r-r—which may be kept up almost incessantly during the active mating season. I have never been able to observe any definite rhythmic synchronism in the chirping of these burrowing crickets. However, late in August, during the season of 1918, I attempted an analysis of the notes of two of these crickets which were stridulating at the same time in their underground burrows in a wet spot near Vinson Station, Virginia. These two individuals chirped very persistently, and at times I noted some degree of synchronism.

TABLE II

STATISTICAL ANALYSIS OF 10 DIFFERENT PERIODS OF CONSECUTIVE CHIRPINGS OF TWO MOLE CRICKETS, *Gryllotalpa Borealis*

Period	Consecutive Chirpings Recorded	Chirpings in Unison	Chirpings Not in Unison	Per Cent. of Chirpings in Unison
First	46	30	16	65.2
Second	36	18	18	50.0
Third	62	36	26	58.0
Fourth	53	28	25	52.8
Fifth	28	16	12	57.1
Sixth	48	21	27	43.7
Seventh	37	14	23	37.8
Eighth	47	29	18	61.7
Ninth	21	10	11	47.6
Tenth	46	20	26	43.4
Total	424	222	202	52.3

From these data, which indicate that out of a total of 424 chirpings only 222, or 52.3 per cent., were in unison, it would appear that there was no particular tendency to maintain a definite synchronism in their chirpings.

The most remarkable instances of rhythmic synchronism I have ever heard have been afforded by the cone-headed grasshopper of the species *Neoconocephalus exiliscanorus* (Davis). A careful study of the intermittent notes—zeet-zeet-zeet-zeet—of these locusts was made on the edge of a swamp near Vinson Station, Virginia, late in August, 1917.

The characteristic habit of stridulation for individuals of this species is to produce a certain number of consecutive notes, followed by a brief pause. Usually, from fifteen to thirty consecutive notes are delivered before the pause takes place, then stridulation is again resumed. Rehn and Hebard[2] mention this habit as follows:

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[2] Rehn, James A. G., and Hebard, Morgan, "Studies in American Tet-

The number of consecutive times without pause that this sound was produced were on one occasion counted, 26–14–20–20–17; usually on a warm evening an undisturbed singer would average about as above before ceasing a few seconds. The song is rapid, the sounds being emitted on warm evenings about 3 to the second.

When stridulation has become fairly established in a colony of these locusts, for the evening, it is likely to be continuous, for if some singers cease their notes briefly, others take it up. Rehn and Hebard, in the publication mentioned above, have also noted this behavior and say:

> When near a colony of this species on favorable evenings after dark the air is vibrant with the sound; as several singers cease others take up the constantly rising and falling song, but at no very great distance the song is inaudible.

In the colony observed by the writer at Vinson Station, Va., three individuals which were somewhat isolated from the rest maintained a perfect rhythmic synchronism for many minutes at a time, including in this period many hundreds of consecutive notes. Now and then all three would be stridulating at the same time, then only two would produce their notes, yet the same perfect rhythmic synchronism was always evident. Sometimes all but one would cease to stridulate, then one or both of the others would again take up the rhythm with a precision that was marvelous. It did not matter how often one or another individual joined the chorus following a pause, the notes were always perfectly synchronous from the start and the rhythmic synchronism was maintained.

A representation of this perfect synchronism which was evident as the different "singers" took up the rhythm from time to time may be shown graphically with dashes as follows:

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On several different nights I observed the same marvelous rhythmic synchronism in this particular group of individuals. Although other groups were "singing" elsewhere, it appeared

tigoniidæ: A Synopsis of the Species of the Genus *Neoconocephalus* found in North America, North of Mexico," in *Trans. Ent. Soc.*, 40, Jan. 6, 1915, pp. 365–413.

that their notes were delivered independently of the rhythm of this particular group. From observations of the stridulations of other groups in this same colony, I am of the opinion that it is not unusual for these locusts to develop a rhythmic synchronism in small groups.

It would be interesting to know why some species of locusts and crickets possessing the intermittent habit of stridulation tend to develop a more or less perfect rhythmic synchronism while others do not. Although this is true of the two crickets, *Œcanthus niveus* and *Cyrtoxipha columbiana,* I have been unable to note any synchronism in the chirpings of the common arboreal cricket, *Orocharis saltator.* Although large colonies of these crickets may often be heard in stridulation, each individual appears to stridulate in its own leisurely manner independently of its fellows.

H. A. ALLARD

WASHINGTON, D. C.

ON THE PIGMENTATION OF A CLYPEASTROID, MELLITA SESQUIPERFORATUS LESKE[1]

THE common clypeastroids, *Echinarachnius* and *Mellita,* when adult, are characteristically of a brown or (in the former species) reddish-brown color. This seems to be general throughout the group. Taxonomic lists contain, however, numerous references to a greenish coloration of the test of these animals. When preserved in alcohol, or when dried, either after fixation in alcohol or after killing with fresh water, these sand dollars usually assume, for a time at least, a somewhat greenish color. Clark (1899, p. 118) says that specimens of *Mellita sesquiperforatus* Leske (=*sexforis* A. Ag.) collected at Jamaica were delicate olive green [when alive, I infer, though with doubt]. He also gives the coloration of specimens of this species obtained in Porto Rican waters as "usually light olive green (rarely brown) when alive." At Bermuda living individuals of this species are, he says, invariably brown, with no hint of green about them, either on the external surface or in the viscera. When killed in alcohol, however, they become green, and greenish pigment is dissolved by the fluid. This is also true of *Echinarachnius parma* (Clark, 1904, p. 564; Coe, 1912, p. 111).

Now, examination shows that there is at the bottom of this

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[1] Contributions from the Bermuda Biological Station for Research, No. 90.